CLAIMS

[1] A compound semiconductor film being a film of a semiconductor containing:

A. at least one element selected from zinc, tin, cadmium, indium, and gallium;

B. at least one element selected from oxygen and sulfur; and

C. an element of Group IIa.

[2] The compound semiconductor film according to claim 1,

wherein the element of Group IIa is at least one element selected from magnesium, calcium, strontium, and barium.

[3] The compound semiconductor film according to claim 1,

wherein the compound semiconductor is:

Zn(O, S):element of Group IIa;

Zn(O, OH, S):element of Group IIa;

Sn(O, OH, S):element of Group IIa;

Cd(O, OH, S):element of Group IIa;

CdZn(O, OH, S):element of Group IIa;

ZnSn (O, OH, S):element of Group IIa;

In(O, OH, S):element of Group IIa

Ga(O, OH, S):element of Group IIa;

InGa(O, OH, S):element of Group IIa

ZnGa(O, OH, S):element of Group IIa

ZnIn(O, OH, S):element of Group IIa;

CdS:element of Group IIa;

ZnS:element of Group IIa;

In_2S_3:element of Group IIa;

Ga_2S_3:element of Group IIa;

In_2O_3:element of Group IIa; or

Ga_2O_3:element of Group IIa,

where bracketed symbols of the elements represent anion groups necessary for keeping charge neutrality with metal ions (ion groups), the charge neutrality being kept by metal ions (ion groups) and anions in the brackets.

[4] The compound semiconductor film according to claim 1, having a volume resistivity of not less than 5×10^8 Ω·cm and not more than 1×10^{11} Ω·cm.

[5] The compound semiconductor film according to claim 1, being expressed by a general formula of $MIIa_x(O, S)$ or $MIIa_x(O, OH, S)$,

where

M represents at least one element selected from zinc, tin, cadmium, indium, and gallium, and

x represents a value in a range of 0.0008 to 0.012.

[6] The compound semiconductor film according to claim 1, having a film thickness in a range of not less than 10 nm and not more than 150 nm.

[7] A method for producing a compound semiconductor film comprising the steps of:

preparing a material solution by dissolving in water a compound containing at least one selected from the group consisting of zinc, tin, cadmium, indium, and gallium, and a compound containing sulfur, and a Group IIa element compound containing an element of Group IIa; and

bringing the material solution prepared at a predetermined temperature into contact with a substrate so that a compound semiconductor film is deposited on the substrate, the compound semiconductor film containing:

A. at least one element selected from zinc, tin, cadmium, indium, and gallium;

B. at least one element selected from oxygen and sulfur; and

C. an element of Group IIa.

[8] The method for producing a compound semiconductor film according to claim 7,

wherein as the Group IIa element compound, a chloride of an element of Group IIa, an iodide of an element of Group IIa, a bromide of an element of Group IIa, a nitrate of an element of Group IIa, a sulfate of an element of Group IIa, or an acetate of an element of Group IIa is used.

[9] The method for producing a compound semiconductor film according to claim 7,

wherein in the step in which the compound semiconductor film is deposited, the material solution has a pH in a range of not less than 9 to not more than 11.

[10] The method for producing a compound semiconductor film according to claim 7,

wherein in the step of preparing the material solution, the pH of the material solution is adjusted by dissolving ammonia additionally in the water.

[11] The method for producing a compound semiconductor film according to claim 7,

wherein in the step of preparing the material solution, , the pH of the material solution is adjusted by dissolving an ammonium salt additionally in the water.

[12] The method for producing a compound semiconductor film according to claim 11,

wherein in the step of preparing the material solution, at least one compound selected from the group consisting of ammonium acetate, ammonium chloride, ammonium iodide, and ammonium sulfate is used as the ammonium salt.

[13] The method for producing a compound semiconductor film according to claim 7,

wherein in the step in which the compound semiconductor film is deposited, the predetermined temperature of the material solution is in a range of not lower than 10°C and not higher than 100°C.

[14] The method for producing a compound semiconductor film according to claim 7,

wherein in the step in which the compound semiconductor film is deposited, the substrate is immersed in the material solution.

[15] The method for producing a compound semiconductor film according to claim 7,

wherein in the step of preparing the material solution, at least one compound selected from the group consisting of acetates, chlorides, iodides, and sulfates is dissolved in the water as the compound containing a metal.

[16] The method for producing a compound semiconductor film according to claim 7,

wherein in the step of preparing the material solution, at least one compound selected from the group consisting of thiourea and thioacetamide is dissolved in the water as the compound containing sulfur.

[17] A solar cell comprising:

a substrate;

a conductive film;

a light-absorption layer;

a compound semiconductor film; and

a transparent conductive layer,

these being stacked in the stated order, or in the order of the substrate, the conductive film, the compound semiconductor film, the light-absorption layer, and the transparent conductive layer,

wherein the compound semiconductor film contains:

A. at least one element selected from zinc, tin, cadmium, indium, and gallium;

B. at least one element selected from oxygen and sulfur; and

C. an element of Group IIa.

[18] The solar cell according to claim 17,

wherein the element of Group IIa is magnesium, calcium, strontium, or barium.

[19] The solar cell according to claim 17,

wherein the compound semiconductor film is expressed by a general formula of $MIIa_x(O, S)$ or $MIIa_x(O, OH, S)$,

where

M represents at least one element selected from zinc, tin, cadmium, indium, and gallium, and

x represents a value in a range of 0.0008 to 0.012.

[20] The solar cell according to claim 17,

wherein the compound semiconductor film has a film thickness in a range of not less than 10 nm and not more than 150 nm.

[21] The solar cell according to claim 17,

wherein the light-absorption layer is formed with a compound semiconductor containing an element of Group Ib, an element of Group IIIa, and an element of Group VIa.

[22] The solar cell according to claim 17,

wherein the compound semiconductor of the light-absorption layer contains:

Cu as the element of Group Ib;

at least one element selected from the group consisting of In and Ga as the element of Group IIIb; and

at least one element selected from the group consisting of Se and S as the element of Group VIb.

[23] A method for producing a solar cell comprising the step of either:

stacking a substrate, a conductive film, a light-absorption layer, a compound semiconductor film, and a transparent conductive layer in the stated order; or

stacking a substrate, a conductive film, a compound semiconductor film, a light-absorption layer, and a transparent conductive layer in the stated order,

wherein the compound semiconductor film is formed by:

preparing a material solution by dissolving in water a compound containing at least one selected from zinc, tin, cadmium, indium, and gallium, a compound containing sulfur, and a Group IIa element compound containing an element of Group IIa; and

bringing the material solution prepared at a predetermined temperature into contact with at least the substrate so that a compound semiconductor film is deposited, the compound semiconductor film

containing:

A. at least one element selected from zinc, tin, cadmium, indium, and gallium;

B. at least one element selected from oxygen and sulfur; and

C. an element of Group IIa.